

SCHEDULING COORDINATION OPTIONS STUDY

**Prepared for
THE BUREAU OF RECLAMATION**

By



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Introduction

The United States Bureau of Reclamation (Reclamation), working closely with representatives of the Reclamation's water customers, the United States Fish and Wildlife Service, Western Area Power Administration (Western), and Western's long-term firm power customers (preference customers), are investigating several options for operation of the Central Valley Project (CVP) after the current integration contract with the Pacific Gas & Electric Company (PG&E) terminates in 2004. The options under review place Reclamation, Western, or a third party in the role of the Scheduling Coordinator (SC), with the responsibility of furnishing balanced power schedules to the California Independent System Operator (CISO). Depending upon the role that Reclamation chooses, different functions, staffing levels, responsibilities, and infrastructure costs may be experienced. Navigant Consulting, Inc. (NCI) was asked to review the options under consideration and furnish an estimate of the costs associated with each option to aid in the decision-making process.

Background

The CVP System consists of ten hydro generating facilities, a high voltage transmission system, and a large number of pumping plants that provide for irrigation and drainage pumping in the Central Valley of California. The CVP system is currently operated under a contract with PG&E (Contract -2948A) that integrates the operation of the CVP system with the system of PG&E. PG&E supports the project loads and Preference Customer loads to an established load level, providing energy deficiencies and absorbing generation surpluses when they occur. When Contract -2948A terminates, the operation of the CVP system will have to interface with the new operational and market structure in California. The PG&E transmission system used for energy deliveries currently, and in the past, has been placed under the operational jurisdiction of the CISO. Therefore, in order to deliver power to Preference Customers and to the Project Loads, the CISO protocols and procedures must be used.

The CISO procedures require that energy schedules for each hour of each day must be balanced. This means that Project Load and customer schedules must match the generation and purchases intended to serve the loads each hour. If such a match does not exist, either purchases must be scheduled or imbalance energy procured from the CISO. In general, purchases from third parties are less expensive than the imbalance market. In order to maintain costs of serving

customer and Project Load as low as possible, purchases must be made for the hour in which they are needed, and Project Load schedules must not be altered. Matching generation to meet load for every hour has not been necessary in the past because of the features of Contract -2948A. This change in procedure leads to development of options considering who will perform the matching function and what are the costs associated with each option. This study is intended to identify staffing and infrastructure costs associated with each option.

For the purposes of this review, the Scheduling Coordinator also performs the Scheduling Agent function. The costs developed are those that agencies would incur in order to implement the appropriate option. Costs charged by third parties are not developed in this review and will need to be considered in the overall assessment of impacts. These costs are the result of negotiations and vary depending upon the third party and conditions imposed in the integration contract.

Options

The operational options being considered are:

- New Integration Contract
- Pump Load Following
- Maximum Peaking Generation

New Integration Contract. There are two variations of this option. The first variation of this option (Option 1A) uses a third party as the entity responsible for performing the integration function previously performed by PG&E. The third party would receive CVP generation and Project Load schedules from Reclamation, and CVP customer schedules from Western, and would purchase energy deficiencies or sell surplus energy from/to third party suppliers/purchasers. The third party integrator is responsible for balancing schedules on a day-ahead and real-time basis, and submitting them to the CISO in accordance with the established procedures and protocols.

The second variation of this option (Option 1B) assumes that Western performs the function of the integrator. Reclamation would supply CVP generation and Project Load schedules to Western. Western would receive the CVP customer schedules and balance the CVP generation, Project Load, and CVP customer schedules with purchases and/or sales to third parties. Western is responsible,

under this option, for submitting schedules to CISO on a day-ahead and real-time basis in accordance with established procedures and protocols.

Under this option, the integrator is responsible for the interface with the CISO and for maintaining balanced schedules. Generation and Project Load Schedules are determined as water operation dictates, with any optimization being performed by the integrator. Third party purchases and sales are made by the integrator using any contractual or physical generation available to the integrator.

Pump Load Following. This option requires Reclamation to serve Project Load with CVP generation for every hour, and to provide information to Western showing surplus generation available, on an hourly basis, to serve CVP customers. This option contains three variations. The first variation (Option 2A) uses a third party as a scheduling coordinator. Reclamation provides CVP generation and Project Load schedules to the SC, and information concerning surplus generation to Western. Reclamation furnishes the unbalanced generation and Project Load schedule to the SC. Western receives CVP customer schedules and balances them with surplus generation and purchases/sales, providing the balanced schedules to the SC. The SC provides balanced schedules to the CISO and balances any generation/load imbalances with purchases and sales.

The second variation of this option (Option 2B) uses Western as the SC. CVP generation is again patterned to serve Project Load first, with surplus information given to Western. In this variation, Western performs the balancing of CVP generation, CVP customer schedules, Project Load, and purchases and sales. Western would be responsible for interfacing with the CISO and maintaining balanced schedules.

The third variation of this option (Option 2C) uses Reclamation as the SC. Reclamation would pattern CVP generation to meet Project Load, and balance hourly schedules with SC to SC trades with Western. Reclamation would not act as the SC for Western. Reclamation would also make purchases to compensate for any deficits in energy in order to meet Project Load. Western would balance the surplus generation (SC to SC trades) and purchases with CVP customer schedules and submit these balanced schedules to the CISO.

Maximum Peaking Generation. This option also has three variations associated with it. Under the first variation of this option (Option 3A), Reclamation would pattern the CVP generation to provide the greatest amount of energy during the peak hours of the day, regardless of the Project Load. Reclamation would schedule Project Load at times when prices from the market were the lowest. These unbalanced schedules would be provided to a third party SC. Reclamation would provide CVP generation schedules to Western, and Western would balance CVP generation, CVP customer schedules and purchases/sales, and provide these balanced schedules to the SC. The SC would purchase to balance Reclamation's Project Load schedule and submit balanced schedules to the CISO.

The second variation of this option (Option 3B) assumes that Western is the SC. Reclamation would furnish the unbalanced schedules for CVP generation and Project Load to Western, and Western would provide balanced schedules of CVP customer schedules, third party purchases, and CVP generation to the CISO.

The third variation of this option (Option 3C) assumes that Reclamation is the SC. Again, Reclamation would not act as the SC for Western. In this variation, Reclamation would furnish balanced Project Load and third party purchase schedules to the ISO, and CVP generation schedules, as an SC to SC trade, to Western. Western would balance the CVP generation schedules and purchases/sales, with the CVP customer schedules, and submit the schedules to the CISO. Again, generation would be dedicated to the market first, and Project Load would be served from market purchases.

Discussion

Operation under the current integration contract provided for PG&E to support a load level for the CVP of 1152 MW. Energy generated and imported by Western to cover CVP customer energy loads were simply accounted for as going into or out of bank accounts when energy supply was greater or less than the scheduled load. Energy accounting is done on a monthly basis. With the new market structure in California, hourly and daily accounting is required. The accounting or back office function related to the new market structure can be very complex and time consuming. Reclamation is not currently staffed to provide the complex accounting that is required, nor does it have the hardware and software tools needed to account for the hourly settlement data.

Project Load for the CVP consists of approximately 130 separate metering points. On a daily basis, Reclamation schedules only the large loads at Banks, Dos Amigos, Tracy, O'Neil and San Luis. The rest of the loads are estimated using assumed load patterns and historical peaks. Under any of the operational scenarios created by the alternatives above, Reclamation will have to provide telemetering and/or come to some agreement with the SC, Western, or the CISO on load patterning in order to schedule for the Project Loads. Currently, scheduling for the large pumping plant loads is done by the CVP water operators, after they are provided with the amounts of water needed to be pumped. Western uses the assumed load patterns and peaks to "dummy in" load data for load monitoring purposes to protect the 1152 MW load level.

The scheduling of CVP generation and Project Load is currently performed by the CVP hydro system controllers and water operators. The schedules are provided to PG&E and Western. If changes are desired by PG&E, Reclamation attempts to accommodate those changes. Reclamation attempts to maximize off-peak pumping, but during certain times of the year must also pump during some of the peak hours of the day. Reclamation does not attempt to follow the pumping load, nor does it currently attempt to maximize peak hour generation. If either Option 2 or Option 3 (or any variation) is adopted for the post-2004 period, additional staff and hardware/software tools will be necessary. Additionally, if a third party or Western were chosen to perform the integration services currently performed by PG&E (Option 1), the integrator will want to schedule CVP generation and Project Load to maximize revenues. No matter which option or variation is chosen for post-2004 operation, Reclamation will have to provide staff and the tools necessary to schedule CVP generation and Project Load in a manner consistent with the requirements of the role it assumes.

The additional staffing and hardware/software costs will depend to some degree on the functions that Reclamation assumes under to the role it chooses. The necessary functions to be performed for the CVP system and support of CVP customer loads in the post-2004 period are:

- Day ahead scheduling
- Real time scheduling
- Accounting, Verification, and Invoicing

Day Ahead Scheduling

Option 1A. Reclamation will perform the day ahead scheduling of hourly CVP generation and Project Loads in accordance with water release requirements in much the same manner as is done today. However, the third party integrator will attempt to maximize its revenues by making the most energy available during high value time periods. Day ahead scheduling is very likely to require numerous iterations, depending on the developing shape of hourly market prices. Each iteration of CVP generation and water movement will have to be “played through” the water system to be certain that water is available to the Project Loads and water customers in the desired pattern without impacting on CVP reservoir and water diversion operations.

Existing personnel and tools can be used for the generation scheduling function, but additional staff will be needed to schedule hourly Project Load. Hourly Project Load scheduling, except for the large pumping loads, is not currently required or performed. The hourly “runs” of CVP generation and Project Loads have to be coordinated by two groups within Reclamation. In order to achieve timely response to desired changes by the integrator, some restructuring of the organization may be necessary, and some office moves may be necessary. The hourly “runs” in response to integrator requests can be made recognizing that the workload can be expected to increase initially until the new integrator understands Reclamation’s constraints, and until Reclamation personnel understand the integrator’s concerns and expectations.

It is believed that a considerable amount of “fine tuning” of the day ahead schedules will be necessary due to the financial motivations of the integrator. It is very possible that in a short period of time, the integrator will insist on faster models and decision making tools so that Reclamation can examine changes in day ahead schedules more rapidly. It is likely that the integrator would pay the cost of these tools.

Option 1B. This variation of Option 1 will require Reclamation to perform the day ahead scheduling of the hourly CVP generation and Project Loads in much the same manner as is done today. However, Western will need to have commitments to the hourly operation no different than the third party integrator. Reclamation will have to commit to an hourly operation

and understand that changes to that operation may have immediate detrimental effects. Existing personnel can perform the generation scheduling function, but hourly scheduling of Project Loads will require additional personnel. Because of the fact that the same people within Reclamation and Western will be performing these functions, very little time or additional work will be necessary bringing each other “up to speed.” Fine tuning of generation/load runs is not expected to be as prevalent as with the third party integrator.

Option 2A and 3A. Options 2A and 3A are the same from a functional, scheduling, and information flow viewpoint. Whether Reclamation schedules CVP generation to follow pumping load or to maximize the amount of generation available during peak hours, the same processes must be performed. Both of these options utilize a third party scheduling coordinator to balance schedules with purchases and sales from/to third parties and to interface with the CISO.

Under these options, Reclamation would schedule the hourly CVP generation and Project Load. In Option 2A, because the CVP generation is patterned to meet Project Load, Reclamation would have to furnish Western with hourly quantities of CVP generation surplus to load requirements. Western would use these quantities, and make purchases and sales to balance the schedules of the CVP customers with the surplus generation and purchases/sales. The SC would take the unbalanced generation and Project Load schedules and balance them with Western’s schedules. Very few purchases to supply Project Load would be necessary because the generation is dedicated, first, to Project Load.

In Option 3A, the CVP generation is patterned to maximize the energy available during peak hours. Reclamation would determine the hourly generation schedules to perform the maximization function, and would develop Project Load schedules. These unbalanced schedules would be furnished to the SC, and Western would receive the surplus generation hourly schedules. Western would then balance the CVP customer schedules with surplus generation, purchases, and sales, and furnish the SC with balanced schedules. The SC would make purchases to balance the pumping schedules each hour, and would submit all of these schedules to the CISO.

In Option 2A, close coordination between the Project Load Schedulers and the generation schedulers would be necessary. As with Option 1A, this may require some restructuring of the organization and some office moves to facilitate the scheduling. In Option 3A, this close coordination would not be necessary as the CVP generation and Project Load schedules have no direct impact on each other. A few iterations may be needed to be sure that the CVP generation schedules moved enough water at the right time to facilitate pumping, but these efforts could take place in separate parts of the organization. Additional staff would be needed by Reclamation to prepare the hourly Project Load schedules in either Option 2A or Option 3A.

It is important to note that under Option 2A or 3A, with dry year water supply conditions, the SC and Western could be in the market purchasing energy at the same time to meet their loads. This could serve to drive the market price up. Under surplus water supply conditions, the SC could be purchasing CVP generation being sold by Western to intermediaries at a premium price. Generally, it is not good practice to have more than one federal entity in the market attempting to discharge a federal obligation.

Option 2B and 3B. In Options 2B and 3B, Western is the SC that performs the balancing function for CVP generation, Project Load, CVP customer schedules, and purchases/sales, and submits these schedules to the CISO. Reclamation would prepare the hourly CVP generation and Project Load schedules and submit them to Western. In Option 2B, close coordination would again be needed between these two schedules because CVP generation would be set to match the Project Load. Restructuring of the organization and some office moves might be likely with Option 2B. In Option 3B, these schedules could be done in separate parts of the organization, but verification that generation is sufficient and timed correctly would be required. Western would perform the balancing function through purchases and sales, and would submit the schedules to the CISO.

Options 2C and 3C. Under Options 2C and 3C Reclamation acts as the SC with the responsibility to submit balanced schedules to the CISO. Generation and Project Load schedules would have to be matched with purchases made by Reclamation and SC to SC trades with Western. Western would have to provide balanced schedules to the CISO by

balancing the SC to SC amounts, and purchases/sales to/from third parties with CVP customer schedules.

Under either option, Reclamation would need the additional staff to prepare the hourly Project Load schedules, and would have to add other staff to purchase/sell on the market. If Option 2C were chosen, the Project Load schedulers and the CVP generation schedulers would have to coordinate these schedules closely. The “traders” would have to coordinate the SC to SC amounts with their purchases so that imbalances did not occur. If Option 3C were chosen, the Project Load schedules and the CVP generation schedules could be done separately, but would have to again be verified so that adequate water is available at the pumping facilities when pumping is planned. The “traders” would have to coordinate the SC to SC amounts with Western, again so that imbalances did not occur. Under Option 3C, Reclamation would be on the market with substantial volumes of purchases.

Again, it is important to note that either Option 2C or 3C has two entities in the market under certain water supply conditions attempting to make purchases to fulfill a federal obligation. These two market participants may serve to drive the market prices up.

The staffing and hardware/software effects related to the day ahead scheduling process for each option are summarized below. Telemetering and/or load patterning agreements are common to all options shown below:

OPTION	ADDITIONAL STAFF	ADDITIONAL CVP MODEL HARDWARE AND SOFTWARE	ADDITIONAL SCHEDULING AND ACCOUNTING HARDWARE AND SOFTWARE	OFFICE MOVES/ ORGANIZATION RESTRUCTURING
1A	Two hourly Project Load Schedulers	Model refinements paid by Integrator	None	Moving Project Load Scheduling close to Generation Scheduling
1B	Two hourly Project Load Schedulers	None	None	None
2A	Two hourly Project Load Schedulers	Model refinements paid by SC	None	Moving Project Load Scheduling close to Generation Scheduling
2B	Two hourly Project Load Schedulers	Model refinements possibly jointly funded by Western and Reclamation	None	Moving Project Load Scheduling close to Generation Scheduling
2C	Two hourly Project Load Schedulers; Two "Traders"	Model refinements funded by Reclamation	Scheduling and Accounting Package needed	Moving all Schedulers and "Traders" into common area
3A	Two hourly Project Load Schedulers	Model refinements paid by SC	None	Moving Project Load Scheduling close to Generation Scheduling
3B	Two hourly Project Load Schedulers	Model refinements possibly jointly funded by Western and Reclamation	None	None
3C	Two hourly Project Load Schedulers; Two "Traders"	Model refinements funded by Reclamation	Scheduling and Accounting Package needed	Move all Schedulers and "Traders" into common area

The number of additional personnel shown above is based on the need for coverage for vacation, sick leave, and meeting/training coverage. It is also based on the need for a peer review of complex schedules that are expected to result if Reclamation takes on the role of SC. The funding shown for model improvements is based on the entity that would desire to have rapid, optimal response from the CVP model.

Real-time Scheduling. At the present time, Reclamation has two operators on duty around the clock. One operator's duties include control of generation and switching at the powerplants, and the other's duties include monitoring the large pumping loads and maintaining planned reservoir operations. These operators also prepare the generation and pumping schedules for the following day(s). Western has three dispatchers on duty around the clock. Duties for each are spread among real-time scheduling, switching, and load monitoring.

Option 1A. Under this option, Reclamation will be interfacing with a new third party integrator. Real-time changes to pumping and/or generation schedules do not occur frequently under Contract –2948A with PG&E. However, under a new integration agreement, it is believed that hourly optimization will be the goal of the integrator. The new integrator will want to have as many of the Project Loads telemetered to its control center as are possible. They will also have to arrive at some type of load patterning arrangement with the CISO that minimizes the integrator's exposure to imbalance energy purchases. Therefore, it is very possible that many more schedule changes will be necessary on real-time in the future as more loads are monitored. Under normal conditions, the increase in workload can be assumed by the current staff. When flood operations are in progress, additional staff may have to be called in to assist with the scheduling efforts. This happens now but, with the increase in duties, it can be expected to occur for a much less critical flood event that currently requires "call-outs."

Option 1B. Using this option, Reclamation will be interfacing with Western in the role of the integrator. Western will be under the same requirements as a third party integrator, and can be expected to attempt to optimize the Project Load and generation on an hourly basis. The same additional telemetering and Project Load patterning arrangements will be necessary. Current staff can be expected to assume the additional number of schedule changes during any day and, as in Option 1A, above, call-outs may be necessary during less critical flood operations in the future.

Option 2A. This option uses the third party SC to interface with the CISO. CVP generation is patterned to meet Project Load, and the surplus generation quantities are given to Western for use in balancing customer schedules, purchases/sales, and surplus generation. Because generation is patterned to meet Project Load, any changes in either generation or Project Load must be coordinated on real-time. The existing real-time people for Reclamation are located only a few feet apart and such coordination should be fairly easy when changes are required. However, this operational scenario will increase the number of telephone calls necessary. Reclamation will have to inform both Western and the SC when changes occur. Any change in surplus generation will then require changes in purchases/sales by Western, and schedule changes with the SC. Additional staff does not appear necessary on real-time under this option.

Option 3A. Again, Option 3A uses the third party SC to interface with the CISO. CVP generation is patterned to maximize on-peak generation, and Project Load is served through market purchases. Under this option, generation schedule changes will have to be reported to Western and the SC, and Project Load schedule changes will have to be reported to the SC. Coordination between the two operators is not required under this option, but is expected to occur as a function of their proximity. Project Load monitoring workload is expected to increase because of the additional telemetering that will be necessary. Additional staff on real-time does not appear necessary under this option. However, as in Options 1A and 2A, call-outs may be necessary under less critical flood events in the future because of the additional schedule changes that are expected to occur.

Options 2B and 3B. These options use Western as the SC to interface with the CISO. From a real-time standpoint, this would reduce the telephone calls required from generation or Project Load changes, as Western would perform the balancing functions with the CISO whether generation was being patterned to meet Project Load or to maximize on-peak generation. Additional real-time staff does not appear necessary under either scenario.

Options 2C and 3C. With these options, Reclamation becomes an SC, and interfaces with the CISO. Under either of these options, Reclamation's real-time workload increases significantly. Reclamation will be required to produce balanced schedules to the CISO when generation and/or Project Load schedules change. Reclamation will have to also interface with third party suppliers to make purchases, and with Western to make changes to SC to SC trades associated with surplus generation. This will also require the real-time people to be trained in the new scheduling and accounting hardware and software that would be purchased (mentioned in the Day-Ahead Scheduling section above). Because of the increased workload, a third real-time position will be necessary, and current staff will have to be trained in real-time power scheduling and the scheduling and accounting hardware and software systems, so that current staff can "back up" the people in the new position. Either of these options will require the addition of five new people so that the "power scheduling desk" can be covered around the clock.

In summary, Options 1A, 1B, 2A, and 2B do not require additional real-time staff. Options 2C and 3C will require five additional real-time staff. Additional overtime may be required under Options 1A, 1B, 2A, and 2B due to flood operation call-outs.

Accounting, Verification, and Invoicing (Post Accounting Function. Under any of the options chosen, the accounting for generation, Project Load, and purchases will have to be done on a daily basis. This is in sharp contrast to the current method of monthly accounting under Contract –2948A. Because of the large amount of hourly data, Reclamation will have to add staff to deal with daily and monthly verifications, and accounting for energy purchases and sales. The invoicing and/or verifying invoices for payment will also require a substantially greater amount of time than under the current integration agreement.

Option 1A and 1B. Using an integrator, either a third party or Western, Reclamation will have to perform a daily review of data provided by the integrator for Project Load and generation to make sure that proper credit is given for generation, and that Project Load is not over or under stated. Reclamation will have to devise new accounting programs that match the format of the integrator so that daily accounting data can be exchanged correctly.

At the end of each month, Reclamation will have to check the data provided by the integrator so that monthly bills can be verified for processing. This process is generally very time consuming, especially if daily verification is neglected. A considerable amount of time can be spent searching for errors in billing amounts, first finding the day in which the errors occur and then in determining the hours where data does not agree. Once the hours that are inconsistent are found, either scheduling logs or taped conversations must be reviewed. The time period for identifying and locating errors can be very short, usually less than three days. Therefore, Reclamation must “stay on top of” the accounting data so that late charges are not accrued, and so that proper credit is given for the generation provided to the system.

Under Option 1A or 1B, Reclamation will only be interfacing with one entity, the integrator. This makes the process considerably less difficult than when data must be verified with multiple entities. Under Option 1A or 1B, Reclamation should consider adding one permanent staff position for the post-accounting function to augment the person currently performing the post accounting function.

Options 2A, 3A, 2B, and 3B. The same amount of work for the post accounting function will be necessary whether Option 2A, 3A, 2B, or 3B is chosen. Options 2A and 3A are the same as the third party integrator option, and Options 2B and 3B are similar to Western being the integrator. As mentioned above, Reclamation would only be interfacing and verifying information with one entity under these options. Again, one additional permanent staff position is believed necessary if any of these options are chosen.

Options 2C and 3C. Under either Option 2C or 3C, Reclamation will be acting as an SC with the CISO. As an SC, Reclamation will be dealing with multiple entities for purchases, and the CISO and Western for SC to SC trades. The post accounting function workload becomes much greater when interfacing with multiple entities, because the error identification process will compound itself (e.g. when an error is found and corrected with one entity, an error may be caused with another entity). Because of the need to interface with the CISO on SC to SC trades (which can be expected to change on real-time a significant number of times per week) and because of the requirement to deal with multiple entities, Reclamation

should consider adding three full-time staff positions for the post accounting function if either Option 2C or Option 3C is chosen.

Summary

The tables presented below summarize the additional staffing and infrastructure items outlined above for each option, and the associated costs.

Additional Staffing. Additional staffing and associated costs, assuming a salary multiplier of 2.25, are shown below:

OPTION	ADDITIONAL POSITIONS	ANNUAL SALARY	ANNUAL COSTS
1A, 1B, 2A, 2B, 3A, 3B	Two Project Load Schedulers One Post Accounting Position	Two @ \$80,000 One @ \$50,000	\$472,500
2C, 3C	Two Project Load Schedulers Three Post Accounting Positions Two Hardware/Software Positions Two "Traders" Five Real-Time	Two @ \$80,000 Three @ \$50,000 Two @ \$50,000 Two @ \$80,000 Five @ \$70,000	\$2,070,000

Additional Hardware/Software Costs. The additional hardware and software costs are shown below, which assume dual servers for hardware, and a scheduling and accounting package similar to the ACES system developed by Unified Systems, Inc.:

OPTION	SCHED. & ACCT. PACKAGE	CVP MODELING	HARDWARE	TOTAL COSTS
1A, 1B, 2A, 3A	0	0	0	\$0
2B,3B	0	\$50,000	\$10,000	\$60,000
2C, 3C	\$200,000	\$120,000	\$50,000	\$370,000

Other Costs

Other costs are the costs of office moves associated with some of the options. The costs for moves are calculated based on one day (8 hours) productivity loss for five people at a loaded cost of \$67 per hour or \$2,700. This amount is added to the cost of moving two people at \$400 each per day, and a fixed fee of \$200. This totals \$1,000. The total for office moves then is \$3,700. These costs are associated with Options 1A, 2A, 2B, 2C, 3A, and 3C.

Total Costs

The total costs associated with each option are shown below:

OPTION	NON-RECURRING COSTS	ANNUAL COSTS
1A	\$3,700	\$472,500
1B	\$0	\$472,500
2A	\$3,700	\$472,500
2B	\$63,700	\$472,500
2C	\$373,700	\$2,070,000
3A	\$3,700	\$472,500
3B	\$60,000	\$472,500
3C	\$373,700	\$2,070,000

The costs above do not include any costs for Reclamation contracting out the role of SC in either Option 2C or 3C. These are raw costs of personnel, hardware, and software. The costs for personnel were derived using existing federal General Schedule pay rates, and assume that Reclamation could recruit people with these pay rates.